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An IoT Based Smart Irrigation System using Soil Moisture Sensors and Precision Agriculture

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Abstract: The focus on IOT Based precision agriculture to increase the productivity in the farm fields through real time monitoring of agriculture of agriculture field parameters. IOT Based smart Irrigation system can help in achieving optimum water resource utilization in the precision farming landscape. This paper presents an open source technology based smart system to predict the irrigation requirements of a field using the sensing of ground parameter like soil moisture , soil temperature and outside environmental conditions along with the weather forecast data from the internet. The proposed system is based on smart algorithm which considers sensed data along with the weather forecast parameters like precipitation, air temperature, humidity, outside environmental conditions. Collection from each sensor is then aggregated at the base station and forwarded to a gateway. An IOT Based precision agriculture has reported that designing the energy efficient data aggregation method for such IOT Based networks is one of the optimal research challenges. In this paper we proposed a duty cycling data aggregation algorithm reduces the energy consumption and aggregate the residual energy in a cloudy weather. The complete has been developed and deployed on a scaling process, weather the sensor node data is wirelessly collected over the cloud using web services and web based information and decision support systems provides the real time information based on the analyses of sensors data and weather forecasting data. We proposed the efficient path selection approach based on the residual parameters. This paper describes the system and discusses in detail the information processing for a particular period of data consumed in an optimal path. The appropriate results shown in the prediction algorithm.

Keywords: IoT, temperature, humidity, Sensor node

I. INTRODUCTION

Water is a very precious resource and driving force in irrigation. Efficient irrigation watering helps in saving water, getting better plant yields. Reduce dependency of fertilizers and improve crop quality. The remote sensing system are available to measure the soil moisture content, but the quickest and better one is with the use of soil moisture sensor. For successful irrigation , it is necessary to monitor soil moisture content continuously in the irrigation fields. Efficient irrigation management can improve yields, grain quality , conserve water and energy and reduce nutrient leaching. One of the easiest and most effective ways to improve irrigation efficiency is to implement soil sensor technology in irrigation scheduling. The selection of soil moisture probes in an important criterion in measuring soil moisture as different soil moisture sensors have their own advantages and disadvantages. The moisture sensors are used intensively at present because it gives real time readings. The contribution of the paper is Improved Duty Cycled (IDC) Algorithm. The proposed algorithm enhances the performance of the data aggregator node in terms of energy efficiency and Qos efficiency.
In this section we represent a systematic review identifying various research studies conducted on path selection algorithm , dijsktra,s algorithm , adaptive control duty

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cycling algorithm, adaptive duty cycling congestion control algorithm, adaptive harvesting aware duty cycling algorithm and improved duty cycling algorithm(IDC).

Additionally WSNs can be combined with a system that manages the water applied to each field based on the environmental conditions and the feedback sent by the individual sensors. There are several advantages in using WSNs and automated decision systems in agriculture:

- Improved estimation and planning of field irrigation based on the available of water supply.
- Minimization of required human resources , time, and effort in the agriculture production.
- Early detection of possible floods in the field that could be destructive for the crops and proper pumping of the water to mitigate such cases.
- Better coordination between different working groups. for example farmers and technical assistants thanks to a clear division of responsibilities.
- Creation of knowledge gathered from a deployed sensor networks for further applications in the agriculture domain.

Moreover WSNs to collect data from the area without considering the routing data from the sensors to the base station, a technique that could provide improved energy efficiency. IN this paper we propose a system that takes into consideration the historical data and the change of the climate values to calculate the quantity of water that is needed for irrigation.

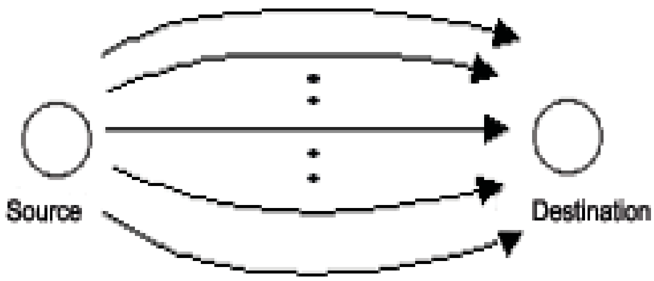
II. RELATED WORK

Path selection algorithm with energy efficiency in agriculture irrigation system. This algorithm is used as the baseline routing protocol and the work focuses on how to make it energy efficient. We describe our routing protocol to evaluate its performance in this following section. Energy should be under consideration when a routing protocol is designed for wireless sensor networks. In this paper we consider not only minimization of the energy required for transmission , but also available energy in the nodes when deciding a right and shortest path.

A path consisting of the nodes that have enough energy for transmission and it as highest selectivity which will be defined in the right path. We choose only one right path in terms of energy and selectivity. There are many possible paths found by considering all the factors such as node energy and the number of times this path has been selected.Whenever the source needs a path to the same destination for transmission.

Performance Evaluation

A right path will be chosen among the discovered paths by taking into account their available energy. Since there are ten different paths , the average value is calculated over the paths. The path selection algorithm selects every path once for each cycle so that all the discovered paths can be used evenly.



In this case one cycle is assumed to consist of ten rounds and one round corresponds to each route request from each source.Our path selection algorithm enables to use all the discovered paths evenly so that the energy consumption may be distributed. The key idea in our algorithm is that all the paths are utilized evenly and the paths with enough available energy are selected, so that the network lifetime can be maximized. By simulation we have found out that the energy in our protocol is dissipated less than the other energy aware routing protocols. This means that our protocol is more efficient in terms of energy. Finally the

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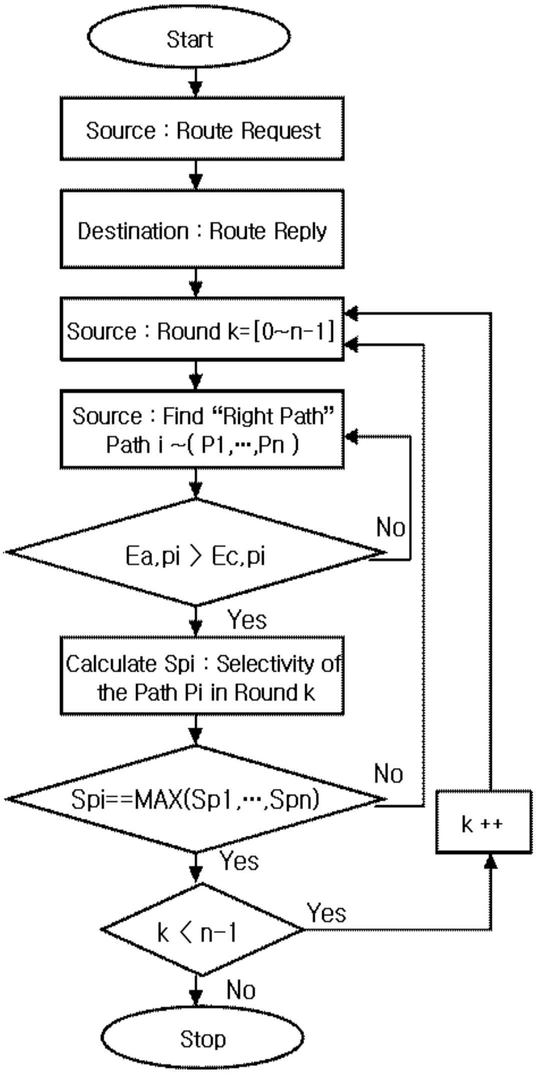
less energy consumes in which path is identified the shortest path of all the consulted rounds.



III. DIJSKTRA'S ALGORITHM

An energy saving routing algorithm based on dijsktra's (ESRAD) is introduced for WSN. It selects the path with least energy consumption by considering energy consumed by nodes electronics and the energy consumption during data transmission phase. It is a centralized routing protocol in which base station assigns weight matrix to the network and then uses dijsktra algorithm to calculate optimal data path from source to sink node. This approach makes it to applicable to the scenarios where periodic or query based data reporting is required. A minimum weight path is selected using this algorithm that improves the energy efficiency of the overall system. The experimental results shows that the proposed algorithm shows better performance that some existing representative methods in the aspects of energy consumption , network life time, and system throughput.Further more , a dijkstra based weighted sum minimization is proposed for wireless sensor networks. It introduces a multi objective function as the link cost between the nodes, which is influenced by the network parameters such as end-to-end delay and path capacity. This scheme analyses the impact of two factors of the network performance by minimizing a weight metric sum through this dijkstra's algorithm. It considers an evaluation index of the node by considering the energy consumption of information processing at the node and energy consumption due to transmission between two connected nodes. This concept is used as a link cost through dijkstra's algorithm to search the path with the least energy consumption. The main drawback of this scheme is that it does not consider the residual energy of the neighbouring nodes, which can result in inappropriate load balancing in the network.

IV. HIERARCHICAL UNEQUAL CLUSTERING FUZZY ALGORITHM (HUCFA)

This algorithm is introduced to reduce the energy consumption of the network. It divides the network area into three horizontal layers based on its distance to base station and then splits each layer into grids. Furthermore it includes cluster head selection scheme which enhances energy efficiency. Nodes are deployed uniformly in the field sensing data. The field monitoring area is divided into three horizontal layers based on the distance of the layer to the base station. Each layer is split into grids. The grid located nearer to the base station will be having more number of cluster head nodes which energy is uniformly consumed. The base

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station located outside the field area to be monitored. The size of clusters in the field reduces gradually with the increase of distance to the base station. After the cluster formation, the cluster head node sends its ready status to its member nodes. The member nodes after receiving the notification from cluster head, it transmits their sensed information to their corresponding cluster head node with a stipulated time period. The information gathered by the cluster head node may include repeated information since the nodes from nearby positions may sense the same data. The depletion of energy in each of the clusters is uniformly decreases. The drawback of this scheme is the consumed energy is not uniformly received from the cluster heads. In our future work we intend to use duty cycling algorithm for selecting a best cluster head inorder to improve the overall network lifetime.

Energy Efficient Clustering Algorithm

This algorithm of clustering and division of nodes into numbers of clusters is implemented, the cluster head is chosen on the basis of distance, the key distribution is carried out via the centralized base station .Then the router is generated from each node to the base station. The data cluster head is sent to the cache, the data is first sent from the cache and then the data is sent from the cluster head. The data set with the corresponding keys decrypts the data.

- Generate the network diagram with the appropriate areas.
- Implement the clustering algorithm over the nodes and divide the nodes into a cluster number.
- Select the efficient cluster head based on energy , number of neighbours and distance from the base station.
- Evaluate the key distribution through the base station at each node.
- Evaluate from each node to the base station the route generations.
- Create data in each node and encrypt the data with the base station.
- Calculate the encrypted data value and record the time.
- Send the individual data from every node of the cluster to the cluster head.
- Collect all the information at the head of the cluster.
- Send data to the base station and aggregate all the data.

The base station accepts the cluster head data.

Simulation Result

The energy consumption for better investigation of the outcomes we have demonstrated for five sequences. Presently the energy transmission incorporates the assets used in delays. We characterize that handling delay signifies the execution time part nodes require to create their delay marks. The aggregation delay is estimated by deciding the time spent checking the marks from all the nodes. The delay shows the time spent on in the end picking up the first information for the base station by confirming the total consumed nodes.

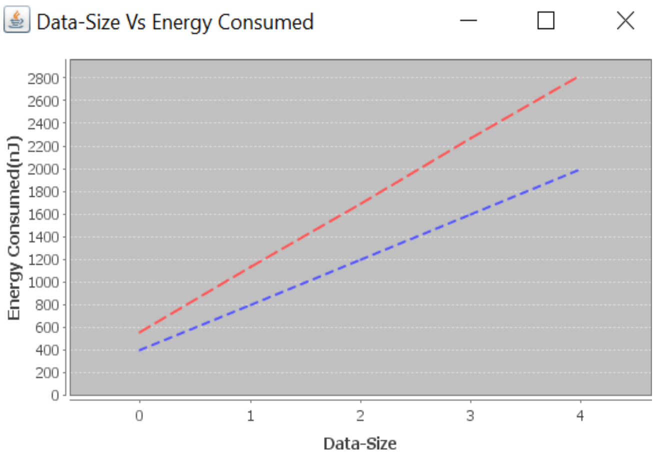

Fig 1. Data – Size Vs Energy Consumed

To evaluate the results the system has been evaluated for different set of nodes for both the existing system and proposed system. The system has been tested for 30 nodes, 50 nodes , 80 nodes and 100 nodes.

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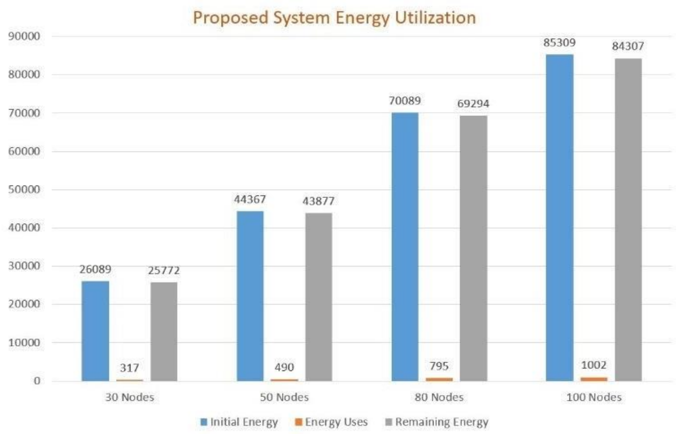

Fig 2. Proposed System Energy Utilization

Energy is one of the most critical resources for wireless sensor networks. Energy conservation was the main objective of literature for optimization for algorithms clustering. The algorithm main point is to allow the whole sensor nodes to complete at random in the network. It is not covered in the whole area of the sensor network. The total sensor nodes are not covered in the optimal path. But the energy will be consumed. So we have to propose to Improved duty cycling algorithm.

Improved Duty cycling Algorithm:

Duty cycling is defined as the division of one period in which a node can be either inactive or sleep rate. In most of the previous methods , the duty cycling is performed on the sensor nodes where in one node is active for a fraction of period, calculate the amount of energy consumed during that period and perform the scheduling between the sleep and active states in a simultaneous way. The objective of this algorithm is to achieve maximize the performance of sensor nodes. This algorithm helps in predicting the future energy based on the previous data. This algorithm is based on energy efficient data aggregation at the base station using residual energy parameters. The Proposed IDC uses two residual energy thresholds one for network and the other

residual energy threshold for path selection. As shown in the algorithm the duty cycled performed on BS node according to network conditions prior to data transmission phase. The proposed optimal path selection and data transmission technique using the remaining energy parameter. The all possible paths from source sensor node to the base station are identified according to this algorithm and then select the shortest path for the data transmission.

V. ALGORITHM: IDC EFFICIENT PATH SELECTION

Input:
S: Set of source sensors;
T: Sink node (IoT BS)
Output: energy efficient shortest path
S_1 :remaining energy threshold value for intermediate node

Source node set *S* and sink node set*T*;

1. Let *Dij*: = c(c>0) and P i j: =0;
2. Let the initial number of intermediate nodes stored at sink node be Φ i: =0
3. **WHILE** t: = 1 to Γdo
4. **FOR** each node i inS
5. Input I0 nodes into the source node*S*.
6. **IF** (I0[t].remaining energy>σ2)
7. Select I0[t] for nexthop
8. **ELSE**
9. DiscardI0[t].
10. **ENDIF**
11. **ENDFOR**
12. **FOR** each node *i* in*T*
14. ***IF*** *Φi≥ I0/(N −1)*
15. Output I0/(N−1) available possible neighboring nodes from the sink nodeTi;
a. **ELSE**
b. Output Φi initial intermediate node from the sink nodeTi
16. **ENDIF**

Simulation Results :

We designed an algorithm IDC and compare it against the state of other algorithm using NS2. The experiment conducted on the Ubuntu operating system and NS2.34 version. We designed the network to check the scalability of the proposed protocol.The below figure showing the throughput, processing time,

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energy consumption, and remaining energy investigation day wise respectively from the same network.we assumed the day 1,2 and 3 in three time intervals of total simulation time to show the real time analyses. The results shown in the figures are representing the performance of the proposed algorithm in different weather conditions. For example day 1 represents sunny weather, day 2 represents partially cloudy, day 3 showing fully cloudy weather. As shown in the first figure , as the day progresses, performance of throughput decreases due to the depletion in the sensor nodes energy from day1 to day3. As the figure 2 takes less processing time to transmit the data under any weather conditions. As the results shown in fig 3 and 4 are representing the performance merit of IDC based on energy consumption.

VI. CONCLUSION AND FUTURE WORK

This paper has to be studied with duty cycling algorithm with IOT Based precision agriculture system. Performance of the proposed Improved duty cycling algorithm is evaluated and compared analysed with other algorithms. The simulation results shows the superiority of IDC over other two algorithms. We represent the simulation results for the evaluation of proposed Improved duty cycling algorithm. The simulation result of the proposed algorithm is showing the improvement in energy efficiency as well as throughput performance. For future work, it will be interesting to investigate the energy efficient clustering based technique to optimize the network lifetime performance.